

Promoting Usability in Health Organizations: Initial Steps and Progress Toward a Healthcare Usability Maturity Model



**HIMSS Health IT User
Experience Committee**

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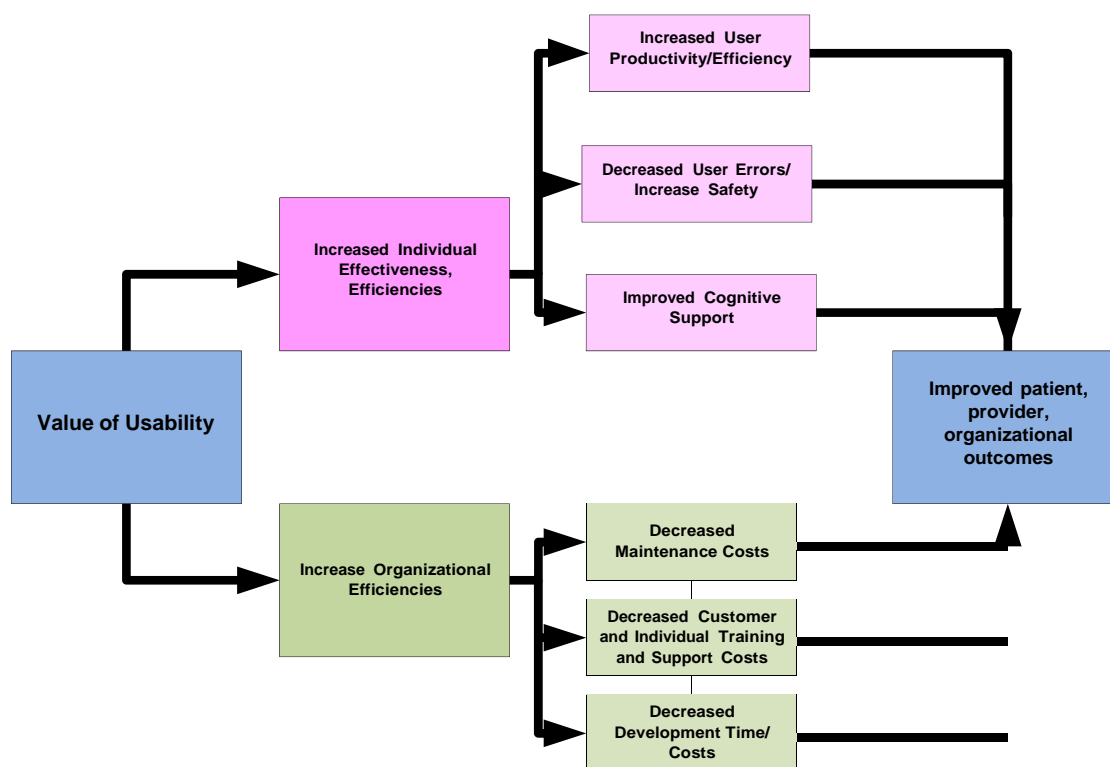
Executive Summary

Federal funding in health IT is stimulating the adoption of electronic medical records and technical innovation necessary to improve our nation's healthcare infrastructure and the systems of care it supports. Without end-user acceptance of these new technologies, adoption and usage critical to improving healthcare processes will not occur. Organizational leaders will find it essential to improve the user experience in health organizations, such as users' perceptions, responses and use of health products, systems and services.

Issues with product usability are well-documented. To that end, this document has three main purposes: describe the value of usability to healthcare organizations; outline a new health usability maturity mode; and provide initial steps for incorporating usability and improving the user experience in healthcare organizations. The document provides material for leaders and individuals in both healthcare organizations and vendor groups. By carefully examining the new usability maturity model and taking its prescriptions seriously, leaders and individuals can systematically improve attention to usability.

Leaders may be reluctant to incorporate usability principles and practices because of perceptions that these methods may slow development and product fielding. However, data exist on usability return on investment (ROI), outlining the value of adopting usability in health organizations (see page 12). The diagram below visually defines ROI factors to be considered.

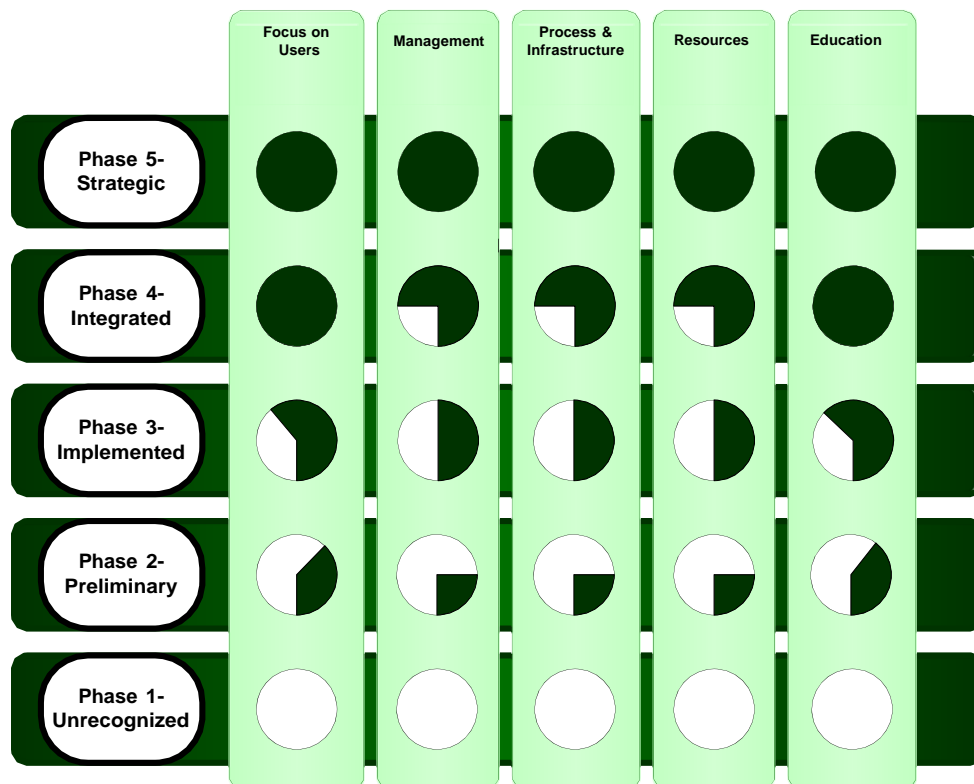
Figure 1: The Value of Usability to Health Organizations



The HIMSS Usability Task Force reviewed three existing usability maturity models from Earthy, Nielsen and Schaffer to assess their potential adoption into health settings (see page 16). Each was found to be incomplete; therefore, the task force used elements from the existing models to create a new Health Usability Maturity Model. This new model is described on page 24 and is diagrammed below.

The Health Usability Maturity Model helps health leaders and individuals assess their levels of usability and then build toward more advanced levels. The model attributes are summarized within the diagram and demonstrate how the different phases of the model correlate with the level of maturity achieved when user-centered design becomes fully integrated within a healthcare organization.

Figure 2: Health Usability Maturity Model



Leaders and individuals may find four general tactics helpful in initiating usability into their organizations: discovering and documenting usability “wake-up” calls, individual infiltration methods, finding internal champions and using external consultants as catalysts. Examples of initial steps for improving the user experience are outlined in the diagram that follows (see page 35).

Figure 3: Initial Steps for Improving User Experience



Three case studies (page 37) illustrate health organizations at different phases of usability maturity on the new Health Usability Maturity Model. The Department of Defense is at Phase 1, transitioning to Phase 2; Baylor Health Care Systems is at Phase 3 and the University Network in Toronto is at Phase 4 and moving to Phase 5. This material outlines the organizations' impetus for usability, resources, projects and outcomes.

Lastly, readers are provided with usability resources (see pages 40-1), including summaries of current national work on usability and useful Web sites. The Usability Task Force's goal is to improve awareness of usability in health organizations by providing tools for improving users' experiences.

Introduction

Leaders and individuals must improve the user experience of health IT for individuals in health settings. That is to say, leaders need to better attend to health system users' perceptions and responses on the use of products, systems and/or services. Current issues are well publicized—poor usability of electronic health records (EHR), sub-optimal device design, awkward ergonomics and negative HEALTH IT/HEALTH IT impacts on patients, patient safety, clinical productivity and efficiency after new products of various types are introduced.

Individuals who select, customize, implement and use, and vendors who produce and/or modify HIT software have an interest in understanding usability maturity in their organizations. A major premise of usability is that software applications are based on an understanding of users' needs; products are not produced in a vacuum or used in isolation.

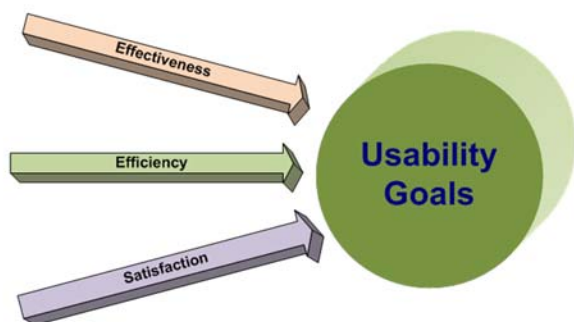
As with most enterprises, user communities and development groups exist. Users, in this case, are primarily healthcare professionals: physicians, nurses, pharmacists and other professionals involved in patient-centered care. Development groups can be in-house health IT departments, vendors, contractors or outside consultants. Understanding how developers and system implementers work with users to create improved products is an important component of the usability maturity described in this document because the level of attention given to user experience, resources directed toward user interface design, resources (e.g., time, money, human, etc.) given and respect each group gives the other often determines a product's success or failure.

Defining Usability and the User Experience

Usability is "the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use."¹ Usability consists of three goals: effectiveness, efficiency and satisfaction. (Figure 4)

Effectiveness is the accuracy and completeness with which specified users achieve specified goals in particular environments, including safety (ISO 9126-1). **Efficiency** includes the resources expended in relation to the accuracy and completeness of goals achieved. **Satisfaction** is the comfort and acceptability of users and other people to the work system.

Figure 4. Usability Goals



User experience is a broader term related to usability but encompasses all aspects of end-users' interactions. The International Standards Organization (9241-210) defines user experience as "a person's perceptions and responses that result from the use or anticipated use of a product, system or service."¹ Shaffer² indicates that the user experience is concerned with a range of experiences such as:

- A customer walking into a bank.
- Integration of mobile and net channels.
- Designs that fit into complex ecosystems with many users all interacting.

Concerns for the user experience go beyond performance to emotional reaction to design and persuasion engineering and ultimately strategy and innovation. To achieve high-quality user experience there must be a seamless merging of the talents of multiple disciplines, such as engineering, marketing, graphical/ industrial design and interface design.³

Purpose of the Document

This document provides critical information for organizational individuals and leaders on increasing awareness of usability and beginning the institutionalization of the user experience into health organizations. The goal is to speak to leaders and individuals in both health organizations and vendor groups. Leaders who understand the importance of user experience, embody its principles and are willing to take a hard look at their areas of responsibility, can deliver change to benefit users, health IT applications, and ultimately their own organizations.

If leaders are not ready for this change, individuals in organizations can use tactics described here to begin educating their organizations. By carefully examining the new usability maturity model and taking seriously its prescriptions, leaders and individuals can systematically improve their attention to usability to everyone's benefit.

The sections of this document describe: the value of usability and improving the user experience in healthcare settings; a new Health Usability Maturity Model outlining the stages for incorporating usability into health organizations; and initial action steps to promote usability into health work settings.

The document provides available resources for promoting usability—three case studies of organizations at various stages of promoting usability, recent reports on usability in the United States and usability Web sites.

Incorporating Usability/User Experience into Health Organizations

In many enterprises outside healthcare, senior leadership levels exist, having responsibility for IT development and deployment over the technical resources and others working with the user community.

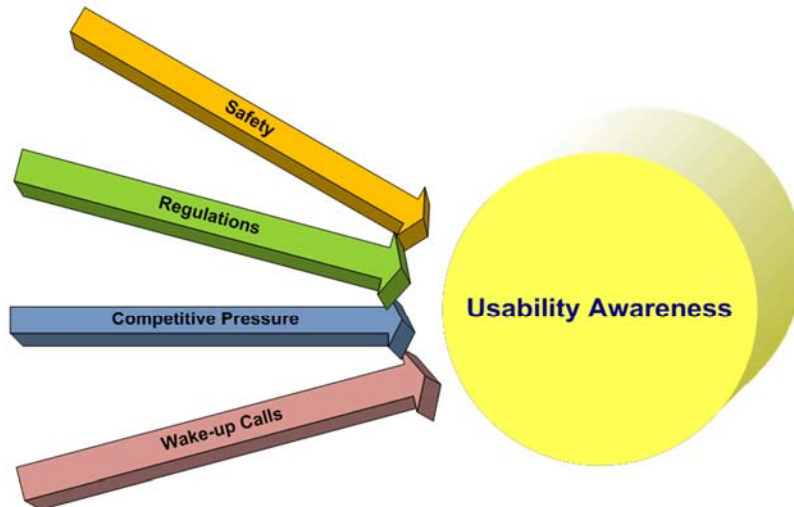
In enterprise applications outside of health IT, titles such as chief experience officer, vice president of customer insights or product manager serve as customer advocates and have the responsibility to see that the best, most usable application is available to customers. Within healthcare, user/customer advocates are much less clear and could contribute to the overall state of poor usability.

This section of the document describes how individuals and leaders in healthcare organizations can begin the focus on user experience to improve product adoption, implementation and use. This focus, while speaking to health IT in this document, extends well beyond software to any health product or process and its fit with work design, implementation and optimal use.

Background: Historical Perspective of Usability

Usability is a relatively young organizational discipline so, in that sense, it is not surprising that it is not universally accepted in every organization. Other disciplines—like marketing—now considered essential departments within a company had a similar path to acceptance until businesses understood how it differed from sales.⁴ The level of awareness and the integration of usability as a key component in product and service development or process engineering vary across industry segments and depend on a number of factors. Some of these drivers of awareness and integration of usability are discussed below. (Figure 5)

Figure 5: Forces Related to Usability Awareness Outside Healthcare



Safety

As in healthcare, safety is a prime consideration to the aeronautics and nuclear power industries because the high risk of harm to large populations. Both industries have a long history of including human factors into their product development, operational procedures and processes.

In the aeronautics industry, design-induced human error has been documented as the primary contributor to more 70 percent of commercial airplane accidents where airplane hulls were severely damaged. Additionally, human error has become a cause for concern in maintenance practices and air traffic management.⁵ It is for those reasons and the desire to improve overall safety that aerospace companies have been employing human factor specialists for more than 50 years.

At Boeing, these practices initially focused on flight deck design, but have now evolved to incorporate a much wider range of disciplines including cognitive psychology, human performance, physiology, visual perception, ergonomics and human-computer interface design. Together, their expertise contributes to the design of Boeing planes, as well as support products that "... help humans perform to the best of their capability while compensating for their natural limitations."⁵

Since optimizing human performance can drastically reduce the likelihood of accidents, Boeing designs human-airplane interfaces and develops procedures for both flight crews and maintenance technicians. Boeing continually examines human performance to improve a plane's usability, maintainability, reliability and comfort.

Human-factors specialists work closely with engineers, safety experts, test and training pilots, as well as cabin crews in analyzing operational safety and developing methods and tools to help operators better manage human error and properly incorporate human factors into the design of all Boeing planes.⁵

The nuclear industry began to focus much more on safety after two significant accidents. The first occurred in 1979, at Three Mile Island. This accident demonstrated the importance of inherent safety features, as its cause was attributed to mechanical failure and operator confusion. Investigations

following the accident led to a new focus on human factors in nuclear safety. Although no major design changes were made, controls and instrumentation were enhanced and operator training was revamped.⁶ Today, there is a great deal of international effort in place to improve safety in the nuclear industry.

Similar issues apply to patient safety in healthcare. An example of such an issue is the wall outlets for medical gases in U.S. hospitals. Common practice included using colored adapters to cue the staff to the correct medical gas (green for oxygen, yellow for room air). From time-to-time however, these adapters were mistakenly placed on the wrong outlets, thus placing the patient in potential danger due to an inconsistency with the wall and adapter colors. To reduce the likelihood of such mix ups happening in the future and to take colorblindness into account, the colored adapters were replaced with clear ones, thus forcing the care provider to look at the wall outlet itself to correctly identify the gas.⁷ This is just one example of how human error can be reduced by better design and increase patient safety.

Regulations

In some industries' regulations have played a role in bringing usability to the forefront. In the United States, 508 legislation enacted in 1998 brought the issue of accessibility for people with disabilities to the forefront. The legislation identified a series of criteria which would be factored into all purchases of IT equipment and software by the federal government. Vendors would have competitive advantage or disadvantage depending on how their products were rated on these criteria. While accessibility differs from usability some of the accessibility criteria (e.g., alt tags) actually contributed to improved usability by enforcing standards which assist sighted users as well as visually impaired users.

Competitive Pressure

Any time the threat of alternatives to unusable products is present, the awareness and integration of usability is generally higher. In consumer products where the purchaser is also the user of the product there is a direct feedback loop from the user to the manufacturer. As the author discovered in user research on the purchase decision process, if that new printer you've just purchased is difficult to install or operate it can easily be returned for a comparable model.

Internet usage is another example of users driving the integration of usability into the development process. A decade ago, if a user couldn't find the information they were looking for or faced barriers on online processes (e.g., form filling, e-purchase) they could easily walk away and find alternatives to meet their goals. This prompted immediate action from organizations to improve their Web sites. "When respondents were asked to list the five most important reasons to shop on the Web, 83% stated 'Easy to place an order' as the top reason."⁸

'Wake-up Calls'

In his book *The Institutionalization of Usability*⁹, Eric Schaffer refers to "wake up calls" within an organization, which alert them to the need for a user-centered design process. A wake-up call can come from a variety of events—a failed product in the market, the introduction of a new executive who champions usability, increasing tech support costs, etc.

A classic case of a wake-up call for usability was documented by McAfee—a developer of antivirus software. Their users are system administrators who use their software to manage antivirus settings on PCs in their domain. McAfee typically receives 100 support calls for every 2,000 downloads of their

software. They targeted the installation and initial use of their software with the aim of improving the user interface. Their goal was to reduce costs by keeping the number of support calls low with the next release. They applied an iterative user-centered design process to the development of the software, getting input from users on their common tasks, as well as issues with use of the prototype and implementing changes based on that feedback. By taking a task-based approach to development, rather than adding unneeded features, they greatly simplified the user experience.

“Too many developers confuse what is possible with what is needed. You’ve got UI (user interface) products out there with 200 different settings; as a user, you’re not sure what to touch. It’s like sitting in the cockpit of a 747.”¹⁰, p. 10

As a result of their usability effort, the 20,000 downloads of the software upgrade generated only 170 calls to the support lines—approximately one-tenth the volume the company would expect with the introduction of a new product. More encouraging for McAfee was that fact that approximately one-third of those calls to tech support were pre-sales calls.

The Value of Usability to Healthcare Projects

As mentioned earlier, the three goals of usability include improved effectiveness, efficiency and satisfaction. These are accepted by usability experts as the triad of important elements for improving the user experience in any situation or setting. This section provides existing evidence for positive impacts on the user experience and tactics for individuals and leaders to use to persuade their organizations to improve user experiences. In healthcare organizations, however, using satisfaction to justify usability may be less persuasive to executives than data about effectiveness and efficiency. Thus, the material below emphasizes efficiency and effectiveness.

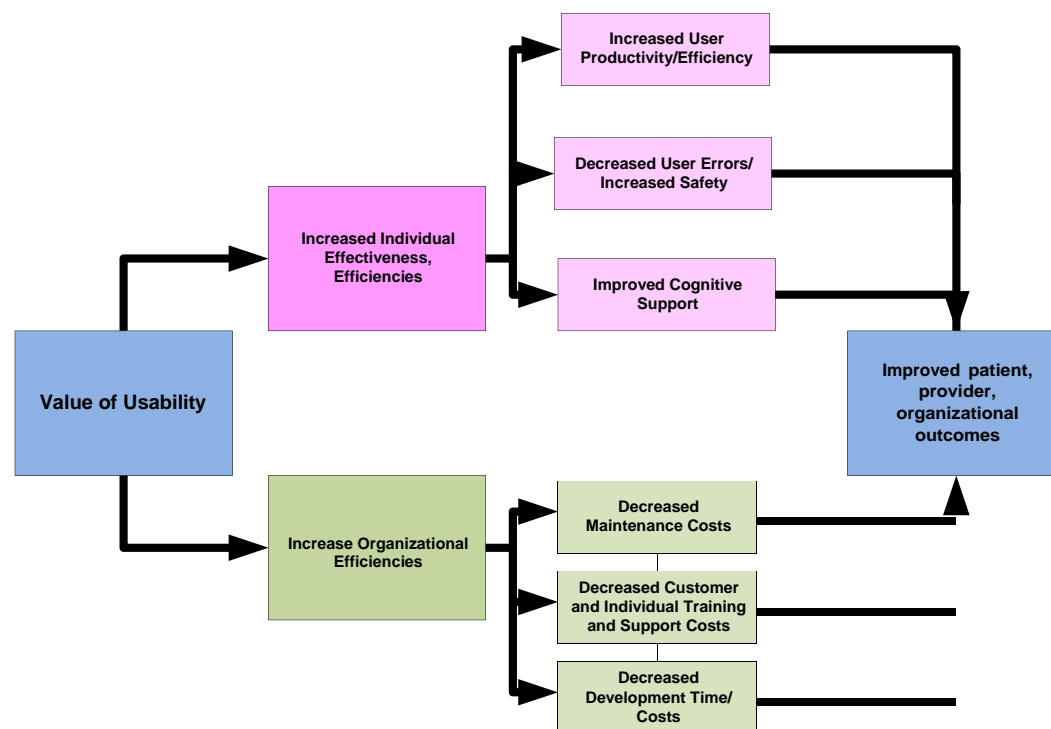
The evidence for the value of usability in terms of ROI and cost savings is more prevalent in the general literature than from healthcare sources. Evidence for return on investment is synthesized across non-healthcare projects by Bias & Mayhew, 2005¹¹; Nielsen, 2003¹²; the [Usability Professionals Association Web site](#); and Dey Alexander Consulting.¹³

A short animated video narrated by Dr. Susan Weinschenk summarizes ROI for usability.¹⁴ The report by Marcus¹⁵ is a compilation of evidence from the literature, while the report from the Nielsen Norman Group¹² is based upon 42 case studies of projects where usability metrics were applied before and after Web site design. Nielsen and colleagues found only five case studies about metrics after intranet redesign. In fact, Nielsen released a recent call for similar intranet case studies in late 2010. Material is available at [Dey Alexander Consulting](#)¹³, and the Forrester report, Get ROI from Design.

Readers also are provided with material outlining the particular value of usability to health informatics projects. To the authors’ knowledge, virtually no research is available about overall ROI or cost savings due to usability efforts on healthcare projects. Instead, examples of the impact of poor usability and findings from usability research projects are cited. These reports support, albeit in the negative, our claims about the major value that increased usability efforts could provide for health informatics projects. Most important, the value extends to EHRs as well as other technologies, such as medical devices.

Figure 1 indicates major values of value of improving the user experience by incorporating human factors and usability into organizations.

Figure 1. Elements of the Value of Usability to Health Organizations



Increased Individual Effectiveness and Efficiency

Providers and other individuals in healthcare organizations have always mentioned ease of use as a top priority for health IT. However, health organization leaders and health informatics vendors may view incorporating usability into projects as adding time, effort and costs.

Yet, usability principles and methods can offer considerable benefit to health IT projects. Systematic evidence for ROI and cost-savings due to usability efforts is currently not available for health IT projects, but the field has ample evidence of the impact of poor usability on health IT users. Usability can positively impact at least these areas of particular interest in health IT: increased user productivity and efficiency; increased safety, including patient safety; improved cognitive support for clinicians; and organizational efficiencies.

- **Increased User Productivity and Efficiency**

One of the most prevalent complaints about health IT in general and EHRs specifically is that the technology impedes users' productivity. A number of reasons for this are related to usability. Users must search for pertinent information in disparate sections of the EHR and often across different information sources that may include paper.

Institutions may have non-integrated EHRs from different vendors for inpatient and outpatient care. This is the case even for medical centers with highly computerized environments, such as

Northwestern University, the University of Utah and the University of Maryland Medical System. Institutions can easily have 300 health IT applications, only some of which are integrated. Health IT application design may not facilitate easy navigation, ease of learning or remembering and users may need to remember the navigation for numerous systems because they practice in several settings. One of the most compelling factors related to impaired productivity compared to other industries is urgent time constraints in health settings, e.g., 15-minute outpatient visits, tasks in critical care, emergency departments, acute care units and perioperative units.

Data are available on negative productivity impacts due to health IT usability. Several reports documented the negative productivity impacts due to usability of a widely deployed outpatient system.¹⁶⁻¹⁸ Outpatient visits had to be reduced from four to three per hour after system fielding.¹⁶ Cognitive walk-through and naturalistic observations revealed that clinicians worked several hours more per day due to inadequate system design; the system lacked workflow support for clinical specialties; and users had significant work-arounds for non-integrated systems.¹⁷ A cognitive work analysis of the same system in a laboratory setting showed a large number of average steps to complete common tasks, a high average execution time and a large percent of mental operators.¹⁸ Incorporating usability principles and methods into system design would help alleviate major impacts like these on health IT users' productivity.

Poor usability on intranets means poor employee productivity. Nielsen Norman^{12, p. 5} estimated that "productivity gains from redesigning an intranet to improve usability are eight times larger than costs for a company with 1,000 employees; 20 times larger for a company with 10,000 employees; and 50 times larger for a company with 100,000 employees." Web site redesign statistics for the 42 cases collected by Nielsen Norman yielded an average increase in user productivity of 161 percent. After testing intranets for low and high usability, these authors projected a savings of 48 hours per employee if intranets were redesigned for high usability. Souza cited usability research showing that two-thirds of buyers failed in shopping attempts on well-known sites.¹⁹

- **Decreased User Errors/Increased Safety**

One of the major reasons health IT is installed is to reduce errors in healthcare^{20,21}. While clearly some classes of errors such as adverse drug events can be reduced with health IT, technology can create unintended consequences and new errors due to usability.²²⁻²⁴ Usability methods specifically targeted to health IT error reduction are imperative for designing life-critical systems, decreasing user error and improving patient safety.

However, a report by AHRQ²⁵ indicates that EHR vendors, while deeply committed to creating usable products, do not yet commonly employ user-entered design techniques or have dedicated usability resources.

An example of how usability methods can reduce errors is in the area of radiation therapy. *The New York Times* published a series of articles outlining devastating errors in radiation therapy treatment, including human factors and software usability issues.²⁶ Researchers in Canada completed an ethnographic field study and workflow analysis to identify issues with their radiation therapy workflow and associated system design. A user-centered design process was used to redesign the user interface which resulted in significantly reducing common errors.²⁷ In

another example, Kushniruk²⁸ was able to identify how certain types of usability problems were related to errors as physicians entered prescriptions into handheld devices.

Nielsen and Levy²⁹ collected case studies in 1994 and found that across 46 redesign projects with measured user error, the decrease in user error rates was 83 percent. An early study also showed a 25-percent decrease in user errors after screen redesign³⁰. More recent evidence from Jared Spool includes statistics about users finding needed information only 42 percent of the time on 15 large, commercial Web sites, even when they were directed to the correct homepage, and 62 percent of shoppers gave up looking for desired online items on Web sites.¹² Redesigns could improve errors in the latter interactions.

- **Improved Cognitive Support for Clinicians**

Stead and Lin³¹ evaluated premier EHRs in the United States and concluded that even these systems did not provide the required cognitive support for clinicians (i.e., tools for thinking about and solving health problems). Cognitive support may include designs to provide an overview or summary of the patient, information “at a glance,” intuitive designs and tailored support for clinicians in specific contexts. Improved cognitive support can also impact user efficiency and error reduction; it is included as a separate category here because of its critical importance to health products.

Two examples of how usability can provide cognitive support are novel physiological monitoring designs and an EHR dashboard design for patients with a chronic condition. Researchers employed user-centered design and usability testing techniques to create novel designs integrating physiologic data into a graphical object^{32-33,34}. The new design provided integrated, “at a glance” pictorial data changes to clinicians. These graphical objects are now being incorporated into vendors’ products as an adjunct to numerical data displays.

A second example is an outpatient EHR display summary for patients with diabetes mellitus at Intermountain Healthcare in Salt Lake City. In the past, providers looked through various EHR applications to retrieve pertinent information about patients with diabetes: recent laboratory results, home glucose testing results, current medications and preventive care needs specific for patients with diabetes, such as annual eye and foot examinations. Now, data are summarized across these applications into an electronic summary sheet for easy information retrieval and clinical decision-making.

Increased Organizational Efficiencies

Although return on investment statistics are not available for organizational efficiencies due to incorporating usability methods in health informatics projects, similar findings to those in non-health arenas are expected. Well designed user interfaces and systems should translate to savings in support call time, individual user support requirements, support staff, maintenance costs, training resources, training time and user change requests.

- **Decreased Maintenance Costs**

Eighty percent of software lifecycle costs occur in the maintenance phase and are related to unmet user requirements and similar usability problems.³⁵ Usability experts estimated that by correcting usability problems early in the design phase of a project, American Airlines reduced the cost of those fixes by 60 percent and 90 percent.³⁶ At IBM, researchers concluded that it is more economical to consider users' needs early in the design cycle than to solve them later.³⁷

- **Decreased Customer, Individual Training and Support Costs**

A study by Microsoft showed that time for support calls “dropped dramatically” after a redesign of the print merge function in Word™.³⁶ Business analysts found that a well-designed user interface had an internal rate of return of 32 percent realized through a 35-percent reduction in training, a 30 percent reduction in supervisory time and improved productivity.³⁸ Logically, a well designed user interface will require fewer resources to support, less time and effort in training and decreased time on support calls. Souza also cited a Web redesign a lucy.com that resulted in a 20 percent reduction in support calls.¹⁹

- **Decreased Development Time and Costs**

“The rule of thumb in many usability-aware organizations is that the cost-benefit ratio for usability is \$1:\$10-\$100. Once a system is in development, correcting a problem costs 10 times as much as fixing the same problem in design. If the system has been released it costs 100 times as much relative to fixing [it] in design.”¹⁵

This estimate is frequently quoted and while it may be overly optimistic, its main point is clear: It is far more expensive in time, costs and effort to correct issues later in the development life cycle than to complete informed design from the beginning of a project.

Best practices in usability engineering could have alleviated major reasons for inaccurate cost estimates by managers in these areas: frequent requests for changes by users, overlooked tasks, users' lack of understanding of their own tasks and insufficient communication and understanding between users and analysts.³⁶ By including usability techniques, two companies reduced time spent on development, one by 40 percent³⁶ and another by 33 percent to 50 percent.³⁹ An ROI analysis by Karat indicated a \$10 return on each dollar invested in usability.⁴⁰ According to Landauer,⁴¹ when usability is factored in from the beginning of a project, efficiency improvements can be over 700 percent. On a national level, Landauer⁴¹ estimated that the inadequate use of usability engineering methods in software development projects cost the U.S. economy about \$30 billion per year in lost productivity. Of course, in 2011 dollars, the cost would be even more substantial.

This section outlined the value of usability to healthcare organizations. The following section describes a new Health Usability Maturity Model that readers may use to assess their organization's level of maturity and use as a guide to develop usability in their settings.

Toward A Health Usability Maturity Model: Review of Current Usability Maturity Models

Three current usability maturity models were reviewed prior to the writing of this paper. Each is summarized below and a table shows comparisons across the levels of existing models. While each model has its own merits, the authors thought none was a comprehensive, yet straightforward maturity

model for healthcare. The new model, the *Health Usability Maturity Model*, builds on the best elements of the current models.

Schaffer Usability Maturity Model

Eric Schaffer published his book *Institutionalization of Usability: A Step by Step Guide* in 2004.⁹ In this book, Schaffer defines a process for institutionalizing usability. The process is made up of four phases noted in the table below.

Table 1. Schaffer's Process for Institutionalizing Usability⁹

Phase	Estimated Duration
Startup	One Month Minimum
Setup	Six – Nine Months
Organization	Six – Nine Months
Long-term Operations	Ongoing

These four phases are described in more detail below.

The Startup Phase

- Recognition of a wakeup call;
- Selection of an executive champion; and
- Engagement of a usability consultant.

The wake-up call provides the impetus for change. It allows an organization to move from focusing on such things as business objectives or system functionality to a focus on easy-to-use products that can bring value to an organization. To be successful, an executive champion needs to be identified and assigned in order to move the wakeup call forward. Lastly, since usability is a relatively new discipline, most organizations will find value in engaging a usability consultant to assist in instilling this discipline within their organization.

The Setup Phase

- Development of a strategy;
- Initiation of usability training;
- Creation of a usability methodology using the Schaffer Method™;
- Development of tools, templates and testing facilities;
- Development of interface design standards; and
- Showcase of a project.

Each organization will need to develop its own strategy around usability. Whatever strategy is developed, it should be comprehensive and include all facets to assure appropriate resources and funding as the program unfolds.

In this phase, usability training will need to be provided to all those who will be involved in the program to assure appropriate understanding of this discipline as well as the tools that will be used to support a user-centered design process. New user-centered design methods will need to be built into the organization's design process through integration or replacement of existing methods in use. Schaffer has developed a method which can be researched through his publications. In this phase, the organization also focuses on appropriate tools, templates, testing and standards for interface design. It is recommended that the organization develop a showcase project at this point to assist in orienting the organization to user-centered design and to provide proof-of-concept for new methods of development.

The Organization Phase

- Organizational structure;
- Staffing; and
- Additional project selection.

Although Schaffer recommends a centralized group to support usability, he believes that usability needs to pervade the entire organization. Consequently, in this phase, and after proof-of-concept, an organizational structure to support usability should be established and then staffed with usability experts. These experts should be assigned to project teams to assure that usability is considered in the future design of processes and technology. Once established, the organization can then take on a host of projects that will provide meaning and value to the organization.

The Long-Term Operations Phase

- Established usability group

In this final phase, the established usability group supports the usability process by maintaining the usability infrastructure and the skill sets needed to support user-centered design. The usability staff, under the direction of the executive champion, supports all development work carried out in the organization using the Schaffer Method™.

Schaffer believes that there is a path to maturity when introducing usability engineering into an organization. This path to maturity is made up of six levels, as noted in the table below.

Table 2. Schaffer's Level of Usability Maturity⁹

Level	Title	Definition
0	Clueless	Unaware that usability is a formal discipline.
1	Piecemeal Usability	Early adopters dabble in usability, but there is no overall organizational commitment or strategy.

2	Managed Usability	Need for usability recognized, strategy developed, usability design funded, and executive champion appointed.
3	Infrastructure	An infrastructure to support usability is developed and a user-centered methodology is adopted.
4	Staffing	All projects supported to an appropriate usability level because the organization has acquired usability skill sets.
5	Routine Usability	Usability has been institutionalized.

Schaffer believes that over the next couple of decades, usability will become routine and the usability of software products will be an expectation of all people who use technology. It is his belief that usability will assist in moving technology forward and introducing new ideas. This is obviously needed in healthcare, especially as it relates to supporting patient care.

Brief Analysis and Critique of the Schaffer Model

This is a simple, practical model to understand and implement, but it relies on subjective assessment. The model is not overtly built from validated academic models of behavior, but rather from industry experience; hence, it is based on practical application of UCD principles in organizations. There is no specific reference to the healthcare field but the model is general enough that some elements could be applied to healthcare organizations.

Nielsen Corporate Usability Maturity Stages

Nielsen's work on Corporate Usability Maturity Stages 1-8 was first published on Nielsen's Web site useit.com April 26, 2006.⁴² Nielsen lists eight stages of usability maturity for organizations. The stages and their descriptions are summarized in Table 3.

Table 3. Nielsen Corporate Usability Maturity⁴²

Stage	Title	Description
1	Hostility Toward Usability	Designers ignore users. No usability resources allocated.
2	Developer-Centered Usability	Some awareness of the value of usability but no funding. Design teams rely on personal judgment.
3	Skunkworks Usability	Ad hoc usability efforts begin. Usability not formally recognized.
4	Dedicated Usability Budget	Formal budget somewhere but often only one manager. Usability testing after product is completed.
5	Managed Usability	Scattered, funded usability projects with usability testing. Usability resources, manager available.
6	Systematic Usability Process	Recognized importance of usability early in design. Field studies begin. Only key projects funded.
7	Integrated User-Centered Design	Research done before development. All projects have metrics, are tracked
8	User-driven corporation	User data determine future

<p>directions, priorities for the organization, affect many areas of the company</p>
--

Stage 1—Hostility Toward Usability

This stage is typified by the slogan “a good user is a dead user,” where designers ignore users. Instead, the goal is to develop applications and make them work. Nielsen recommends that employees of these organizations at Stage 1 “forget about promoting usability” internally. Organizational attitudes toward usability will change only when the organization is sufficiently hurt by its practices. Then, leaders and development teams will consider usability practices.

Stage 2—Developer-Centered Usability

Organizations realize that usability has value beginning at Stage 2 but usability components or projects are not yet funded. Design teams rely on their own personal judgment about what constitutes good usability instead of including end-users in the design process. This approach works well for users of technical products such as Web servers, but it does not serve users of non-technical applications or tools.

Stage 3—Skunkworks Usability

Individuals at Stage 3 realize that design teams should not rely on their own personal judgments; however, the majority of design teams continue with this practice. At this stage, ad hoc usability efforts will occur. An individual or small group will initiate simple usability efforts such as hiring an external usability expert for a product or quality evaluation. The hallmark of Stage 3 is that usability is not formally recognized in the organization nor is it allocated any fiscal or human resources.

Stage 4—Dedicated Usability Budget

The major difference between Stage 3 and Stage 4 is that a dedicated budget is allocated for usability somewhere in the company. Typically, this is due to a single manager or leader being convinced that the corporation will profit from improving the user experience. No company-wide efforts are in place, usability resources are scattered throughout the organization and dedicated resources are minimal. The main usability method employed at this stage is user testing after some product development occurs. To move from this stage to Stage 5, organizations are encouraged to collect data about internal success stories with measures of interest to the company.

Stage 5—Managed Usability

By Stage 5, organizations are allocating funds to usability efforts although these projects may be scattered around the company and usability budgets may be canceled abruptly. The primary usability method at this stage continues to be usability testing later in the systems development lifecycle, but usability studies are conducted more consistently than at Stage 4. Dedicated usability resources are available including a manager. The group maintains an archive of usability reports which can serve as company-specific design guidelines. Usability resources are not available for all projects.

Stage 6—Systematic Usability Process

Companies at Stage 6 recognize the need for user-centered design beginning early in the development process. An actual user-centered design process is in place with multiple activities and milestones including early paper prototypes and iterative design processes. User research is completed before

design begins. A process is in place to track user experience quality throughout design projects and releases. In Stage 6, upper management monitors usability quality indicators. Field studies begin at this stage. However, only key projects receive sufficient funding for usability efforts. All projects have some usability evaluation before release. To move beyond this stage, all leaders, managers and team members must be convinced of the value of usability and that usability is a component of their jobs.

Stage 7—Integrated User-Centered Design

At Stage 7, field studies of users, tasks and environments become more prominent before development begins. Each development lifecycle step is infused with user data. Leaders track projects with quantitative usability metrics. Every project has usability goals with defined metrics to achieve before product release. Companies begin to use data from usability projects to determine future products.

Stage 8—User-Driven Corporation

By Stage 8, user research data determines strategic directions and priorities for the company. The company employs similar usability methods as in Stage 7 but these methods affect other forms of customer interaction with the company (e.g., design of lobbies, guest rooms). The hallmark of this step is the infusion of behaviorally-driven data throughout the organization and its activities. Nielsen suggests projected timelines for progressing through the eight stages.

Table 4. Estimated Timelines for Nielsen’s Usability Maturity Stages

Stage	Estimated Timelines
1	Can be decades. May take a disaster for corporations to become aware of usability
2-4	2-3 years in each stage. Typically 7 years to reach stage from stages 2-5
5-7	Considerably slower, 6-7 years in each stages, typically 13 years to move for 5-7
8	Premature to estimate, probably 20 years from stage 7 to 8

Brief Analysis and Critique of the Model

Nielsen’s work provides insight into how organizations mature in their incorporation of usability principles and practices. As with any model, some issues can be raised.

First, Stage 1 is titled “hostility toward usability.” Health organization leaders, rather than being hostile, may instead be naïve or apathetic about the value of the user experience and techniques for improving usability. Second, the distinctions among eight stages could be difficult to discern especially as organizations are developing usability resources and projects in Stages 2-5. Nielsen indicates that organizations need to progress sequentially through the stages, although start-up companies may start initially at Stage 2 or 3.

In health organizations, this prescribed method may hinder executives from embracing the model due to the lengthy and proscribed progression through steps. As noted earlier, the time from Stage 1 to 8 can be decades. Borders between stages may be fuzzy. A more parsimonious model may be possible with fewer stages. Another issue is that moving from one stage to another relies primarily on subjective

analysis. Other models might incorporate metrics. Lastly, although the discussion is outside the scope of Nielsen's model, readers could benefit from understanding more about how organizations move from Stage 1, hostility, to embracing aspects of usability.

This model includes a short, easily digestible description on useit.com. Although the model is not specifically targeted to healthcare, its premises are certainly applicable to healthcare organizations, especially those with ongoing development efforts.

Usability Maturity Model: Human Centeredness Scale

Earthy's (1998) *Usability Maturity Model: Human Centeredness Scale* identifies⁴³ six levels to describe an organization's human-centeredness based on an understanding of the organization's attitude, technology and management. The model is both descriptive and prescriptive. First, this model can be used to classify where an organization fits in its progress toward understanding of human-centered issues. (See the checklists in the Earthy paper.) Second, by understanding the issues and attributes, an organization can see what actions need to be taken to progress to the next level. Below are the levels in Earthy's model along with their particular attributes.

Table 5. Overview of the Elements in the Earthy Model⁴³

Level	Title	Description
X	Unrecognized	(no indicators)
A	Recognized	Problem recognition Performed processes
B	Considered	Quality in use awareness User focus
C	Implemented	User involvement Human factors technology Human factors skills
D	Integrated	Integration Improvement Iteration
E	Institutionalized	Human-centered leadership Organizational human-centeredness

Each level is summarized briefly below. For more details see Earthy (1998).

Level X: Unrecognized

At this level, there are "no positive human-centered attributes..." (p. 13). The need for a human-centered process is not acknowledged or even in the organizational thinking. Systems are developed and delivered with little concern for the satisfaction of the end-users.

Level A: Recognized

An organization at the Recognized Level has standard, user-centered development processes to produce applications. The organization's members understand there is a business benefit to usability of their

products, yet they lack the ability to understand the usability problems and channel those to better outcomes. Further, the organization has yet to understand how to collect the correct information from users or write requirements that benefit the users. Little is known about how to improve quality of the user experience. The mindset is still engineering or system focused.

The organizational shift from Recognized Level to Considered Level is a major culture change. Traditional engineering outlooks are replaced by awareness that systems are created to be used by people.

Level B: Considered

Organization-wide awareness is increased through staff training and education that quality *in use* (i.e., usability) is an important system attribute. At the Considered Level, the organization will begin systematically improving and documenting end-user requirements. While some progress is made to improve the user experience through improving end-user requirements and user interface design, other efforts here appear to be directed toward “fixing the user” largely through training.

Improvements and transitions from Considered to Implemented are revealed in a growing awareness to training in the importance of usability, human factors standards, usability methods and the systemic nature of human-system interaction. In many ways, there is a revelation that on the part of a developer that “I am not the user.”

Level C: Implemented

At the Implemented Level, the organization has realized the value of human-centered design techniques and delivers positive benefits to the users. User needs (functionality), as well as human capabilities, are extensively explored and incorporated in system requirements and specifications throughout the development lifecycle. Users are also involved in testing of those applications, as *users* define system quality. Resources (i.e., financial, human and system) are available to the team to carry out human-centered methods.

At this stage of maturity, a formal recognition of the user and user-centered approaches exist and are now routine.

Level D: Integrated

The organization is classified as Integrated when human-centered processes are a part of the quality process and system development lifecycle of the organization. The system development and human-centered lifecycles are *managed* to produce desired outcomes. Resources, including staffing, time and financial commitments, are dedicated to the human-centered design programs.

Language used among user groups, human factors groups, and developers are easily understandable; that is, the groups are integrated and communication is not a barrier. Standards are developed and deployed to guide the human-centered processes. Feedback from testing/evaluation sessions are expected to influence and improve system development iteratively throughout the process, especially early in the design process.

Shifting from Implemented to Integrated involves the developmental culture to be embedded in the business-driven multi-disciplinary culture. The organization undergoes a systematic shift, where user-centered skills are recognized equally with engineering skills.

Level E: Institutionalized

At the Institutionalized Level, usability and user experience are managed for the benefit of the organization. In fact, the organizational culture is one of being human-centered. User-centered design processes are used not only on external applications, but internal systems as well. Usability defects are considered equally with application defects. A competitive and marketing advantage to a user-centered design is realized and positive results are supported by data. Human factors skills are considered equal to technical engineering skills. In short, the user-centered approach affects management of all system development processes.

Brief Analysis and Critique of the Model

As with the other usability maturity efforts, Earthy's model is used to evaluate and develop an organization's user-centered awareness, practice and objectives. The model is well-developed and has good analysis and description of the levels. It does not prescribe specific timelines as do the other authors; however, his check list is very robust.

One of the main benefits of the model is that it comes with a thorough descriptive check list enabling organizations to take an honest look at where they are (based on attributes) and what they would need to do to move forward, as well as *why* it is important to become more mature in the approach to usability. One difficulty in reading this is that the terms used are somewhat different than terms in common use (e.g., human-centered versus user-centered). Earthy's body of work related to usability maturity models continues through the development of an ISO standard for instituting human-centered approaches into software lifecycles (ISO TR 18529).

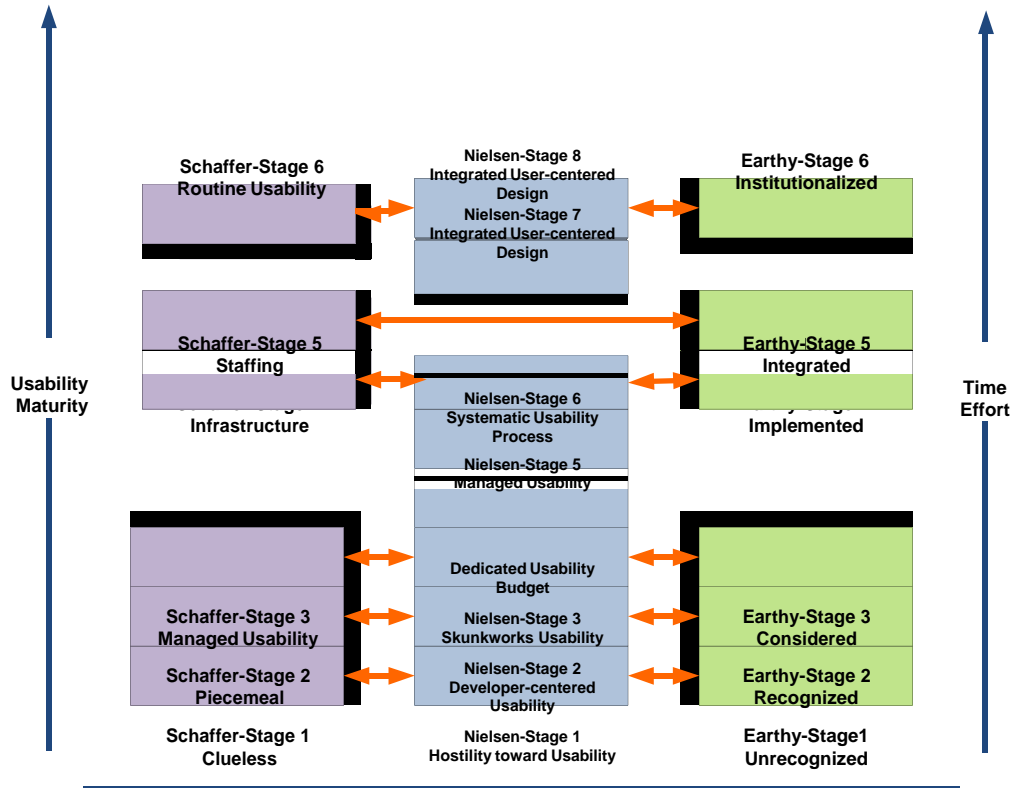
Model Comparisons

Several themes emerged from the research on existing models:

- *Organizational View Toward Users*—generally, the more mature the organization is about usability, the greater the emphasis is in understanding of and designing for users.
- *User-Centered Processes*—less mature organizations have more chaotic usability processes in general, and no accommodation for user centered design; more mature organizations demonstrate a willingness to seek out user feedback (e.g., testing data) as a basis for making design decisions
- *Management Support*—more mature organizations value user experience skills as much as “technical” software development skills and organize to optimize this feedback; management also recognizes the strategic positioning of user experience both as revenue generating and cost-containment. Great user experience equals great business proposition.
- *Resources Allocated*—the more mature the organization the more resources are put toward understanding users and incorporating their feedback into the process.

The following figure demonstrates the similarities among the levels of the existing models.

Figure 6. Comparisons of the Elements in Existing Usability Maturity Models



A New Healthcare Usability Maturity Model

Introduction

A new five-phase model is presented identifying key elements and milestones involved in successfully integrating usability into a healthcare organization. Each phase describes the state of usability within the organization and provides some guidance for moving to the next stage. The five phase include:

1. Unrecognized
2. Preliminary
3. Implemented
4. Integrated
5. Strategic

Glossary

The term “usability activities” is used throughout this section. In this context is it used to mean any structured activity which will improve the usability of a product or system for its intended users. This includes usability research and design activities. For a fuller discussion of specific activities that are part of the User Centered Design (UCD) process, please see the [NIST Guide to the Processes Approach for Improving the Usability of Electronic Health Records](#).

Table 6. Overview of Health Usability Maturity Model Phases

Phase	Title	Definition
1	Unrecognized	Lack of awareness of usability. No practices, policies or resources
2	Preliminary	Sporadic inclusion of usability. Very limited resources
3	Implemented	Recognized value of usability. Small team doing usability
4	Integrated	All benchmarks of usability implemented including a dedicated user experience team
5	Strategic	Business benefit well understood, usability mandated, budget and people part of each year's budget, results used strategically throughout the organization

Phase 1: Unrecognized

Description

This phase is characterized by lack of awareness of the impact of usability on the organization. The organization may be experiencing system problems but cannot tease out usability issues from other issues or does not recognize usability as a core problem. There may be resistance to usability methods from IT groups who feel that they have a process that already accounts for user input. Or, perhaps, because they feel that user input processes will harm their development process by slowing it down or causing confusion at key decision points.

Marketing, health IT, sales, or project management staff might feel that they represent the user's needs and desires. Upper- and mid-level management does not see usability as a concern, or may not have adequate knowledge to understand there are ways to deal with usability issues directly.

Consequently, there are no usability policies in place, and industry standards are not sought to enable usability. Processes for the management of usability may be totally lacking or may be undocumented, un-controlled by policy, reactive or chaotic. Upper-level management typically does not support the inclusion of funds needed to enable usability into capital or operating budgets. Staff, including IT staff, is not conversant with usability concerns and receive no formal training in such.

Transition to Next Phase

The transition to the beginning phase is often triggered by an event—what Eric Schaffer refers to as a “wake-up call”⁴—which brings the concept of usability or user centered design to the forefront. The event may be as dramatic as the failure of a product to perform as intended and users refusing or being unable to use the product effectively; or it may be the introduction of someone into the organization experiencing usability in practice and understanding the benefits of incorporating user-centered design

into the development and rollout of products. It might also be because there are requirements from customers specifically requesting usability research and documentation.

Phase 2: Preliminary

Description

In the beginning phase there will be limited inclusion of usability in product development, selection, customization and deployment. Usability activities may be included in some new product introductions, but UCD will not be practiced in a structured manner. A small group may see the value, but typically budget or resources will not exist to do all the work required. Usability activities tend to be a “skunkworks” operation without the resources or influence in the organization to mandate organizational change.

There may be a reliance on outside experts to execute some usability activities [e.g., usability testing] because there are not enough resources or they do not have the specific skill set within the organization. Although outside experts may be used at any maturity phase, they are most crucial at the beginning phase to help showcase the benefits of usability and provide broader reach for the usability initiative while internal capabilities are developed.

Focus on Users

An emerging focus on end-users begins to develop in the organization, but there will still be competition from experts who claim to know what is best for users. The focus is likely to be on individual users and their issues rather than user groups. This may result in systems being selected or developed to meet the needs of a particular individual rather than understanding the needs of all user groups. As a result, systems or products may not effectively meet user needs and cause some resistance to a user-centered approach.

Management

Senior management may begin to realize that usability is a concern that has an impact on work processes and organizational outcomes. They may, however, see usability as a characteristic that is limited to specific functional areas such as IT development or at certain points in the process (e.g., to conduct usability testing after development is complete). Within the organization there may be the beginning of a systems approach to usability, but this approach is not widely understood nor typically championed by senior management.

There will be little or no management of usability as a process at this phase. Activities will be decided on a project by project basis and will be incorporated into the existing development or deployment process when a crisis occurs [see “wake-up call” above] or when a supporter of usability is present on the team.

Process and Infrastructure

Internal processes for the management of usability are generally in their infancy, but some usability processes may be documented (and repeatable). Generally there is no systematic plan in place that addresses continuous usability improvements. Some documented usability processes may be repeatable, but many will use non-standard benchmarking. Because of this, extensibility within the organization may be unfeasible.

Select portions of user-centered design (UCD) may be included as activities, but generally UCD will not be practiced in a thorough manner. For new systems introductions, some usability activities may be included, but there are no standard processes or criteria for determining whether the system is acceptable. In a development environment visual or interaction designers may be imbedded with development teams, but with little access to systematic user feedback. Within a healthcare organization they may have access to internal systems users and will informally collect feedback when possible, but there may be no research specialists and no budget for collecting user requirements or testing systems during development.

There will be no infrastructure in place to learn from and build on previous system implementation. Learning will be in the heads and personal files of the usability specialists (if there are any) and not shared across the organization. A usability researcher may re-use test materials or reports when starting a new project but no standardized templates or methods will be in place.

Resources

If the organization has hired external usability specialists to support them in new product selection and introduction, they may have acquired an understanding of UCD through these external experts. Typically, there will be limited or no expertise within the organization and no internal champion for usability. Some usability enthusiasts within the organization may have acquired knowledge from previous on the job experience or may have taken some foundational courses on the topic. Usability resources will be assigned/hired in an ad hoc manner to address a specific usability issue.

Education

There will be no awareness program to educate the rest of the organization on the value and business benefits of UCD. Awareness may grow organically based on project successes where UCD has been employed. It may also develop through evangelizing within development teams and related groups. In some cases, a business case or case study may be developed demonstrating the positive impact of usability practices on product usage and user satisfaction. Education of management, particularly executive management, is a crucial step in moving up the usability maturity model.

Skill development for usability specialists will also be limited without an organizational mandate related to usability. Within the organization some staff, typically IT, clinical informatics staff, may have some training in usability concepts but that training is often gained through on-the-job experience rather than from a formal training process. These experienced staff members will often focus on individual users and their issues rather than adopting a more system-wide approach. User consideration may occur in some IT processes, but often occurs post implementation, hence a focus on “user training” to ease new system introduction.

Transition to Next Phase

The transition from the Beginning phase to the Managed phase requires a number of changes in the organization. First, usability and associated concepts of safety and reliability must become recognized disciplines within the organization. This means there will be processes and procedures in place to ensure usability throughout the new system introduction process and to assess and improve existing systems.

To transition to the next phase, awareness of usability practices and benefits must be raised throughout the organization—particularly in the IT and informatics departments. Also, the organization must

recognize that end-users are not experts or analysts, and that the focus of implementation must be on the end-user.

Phase 3: Implemented

Description

At this phase there will be a small team of usability practitioners. These practitioners may be a mix of usability specialists who have been trained in Human Factors or related behavioral sciences and developers who have shown an interest and learned fundamental usability skills on the job.

At the Managed phase some of the infrastructure required to fully integrate usability into the organization will be apparent. The team may have developed some standards; for example, user interface guidelines or usability testing and reporting templates. They may have begun to develop a library of design patterns and previous test results to improve the efficiency of usability activities.

Focus on Users

Users are recognized as important, but their needs may still be traded off for other considerations. For example, developers may develop features in such a way that are easier for them to code rather than easier for the user to use. Or a healthcare organization may develop a workflow that is logical from a system perspective, but difficult from a user perspective.

Management

Senior management is aware that some workflow issues and staff dissatisfaction is related to usability issues. Senior and mid-level management may develop a more proactive approach to usability issues, including the institution of usability evaluation processes for a small number of IT functions and/or applications. This approach may also include documentation and benchmarking that leads to more consistent results, which, in turn, increases the ability of the organization to apply these processes across the work processes of the entire organization.

Typically, there will be a manager of the usability team within IT, clinical systems or informatics who has UCD experience. The manager will have accountability for UCD activities in the organization, but will not yet have a mandate to improve usability across the organization. Although there is no executive champion in place an awareness of usability begins to emerge at the CMO, CMIO, CNO or CNIO level (see Appendix).

The manager will be responsible for assigning staff to priority projects as well as developing infrastructure to support effective and efficient use of each usability activity. A forward-looking manager in this role will assume responsibility to evangelize the value of user experience to the organization, as well as find like-minded individuals in related disciplines (e.g., customer support or technical writing).

Process and Infrastructure

Process and infrastructure start to be put in place at this phase. User interface standards may be borrowed from publically available sources or be developed in-house. A library of design patterns for re-use in future projects emerges. Templates and standardized methods for conducting research will also start to be formalized.

Usability processes for some IT applications are documented and achieve consistent results. At this point a usability improvement plan based on user testing data should be in place for specific applications and it may sometimes be used when processes reach across the organization.

Benchmarking for usability is often guided by industry standards. Upper- and middle-level managers routinely budget to account for costs associated with usability issues. Often suitable tools and facilities for usability enhancements are provided.

Resources

At this phase, there will be budget allocated for usability activities. Corporate resources (e.g., tools and facilities) required to conduct usability activities will be allocated. For example, software for recording usability test sessions may be used. For in-house development projects, software for developing wireframes and prototypes for user testing will be available. Along with employees who have “on-the-job” usability training or human factors trained specialists, the organization may also employ external usability consultants whose focus is on human factors design as well as new technology developments and their successful implementation.

Education

Accountability is assigned for increasing awareness of the UCD process and its benefits throughout the organization. This may take many forms including: formal presentations of the process, case studies of projects which benefitted from UCD, testimonials of internal users participating in the process and using the resulting system, etc.

The organization will also need to provide education and training for teams who will be interacting directly with usability specialists. This should include education on why a user focus is important and how to maintain that focus throughout customization, implementation and development cycles.

The usability team may undertake formal training to update/broaden their skill sets. They will also improve their skills by sharing learning across projects and consulting with experts.

Transition to Next Phase

The transition requires the regular use of usability expertise, methods and tools. While some gaps may still be present, a solid framework needs to be in place to ensure success at the next phase.

Phase 4: Integrated Description

In the Integrated Phase, all of the benchmarks of a usability program are implemented. The usability group has a recognized mandate within the organization and is responsible for ensuring the usability of all IT products and systems within the organization. This accountability is achieved through the same processes of objective setting and measurement used by other departments in the organization. The usability group is involved in the selection, customization, and/or development and introduction of any new products or systems within the organization. Critical resources and infrastructure are in place to support usability activities.

Focus on Users

Users are formally recognized and user focused development is mainstream. User groups are discussed and considered for each system in operation or each planned system. Personas may be developed to represent key users groups and keep the new system introduction team focused on their needs. User data is recognized as a key input for any new product introduction.

Management

Senior, middle, and line managers are all fully aware of usability issues and the need to address them. Users, internal and external, are formally recognized and the organization has become user focused to the point that user focus is mainstream in the organization, and usability standards and policies are firmly in place with individuals and projects being held accountable. Management including CIO, CMO, CNO, CMIO and CNIO (see Appendix) begin to link the ROI of the usability program with the organization's business goals. Super users are engaged in the usability process. Specific case studies of projects where usability program significantly improved system use parameters are used as guidance for new product introductions. Usability-related key performance indicators are developed and modified for monitoring with other business success indicators.

Process and Infrastructure

Usability measurement and improvement processes are consistently and reliably used across most, if not all, of the organization. Benchmarking is fully standardized and consistently used. As a result, cross-organizational learning (across systems and departments) regarding usability impacts begins to occur.

Resources

All projects have a least one formally trained usability expert on the team and the focus of the team includes improving operations and quality of care through usability enhancements (such as error prevention). Extensive user feedback, both internal to the organization and externally, is sought and used. All new and on-going IT projects have budget allocations for usability.

Education

While the usability process is widely understood and accepted within the organization, periodic updates on recent projects are provided to reinforce the positive impact of usability in new systems introduction. Internal systems users have access to results of any usability data related to systems that they interact with. They also have access to usability data for systems with external users that may be relevant to their jobs. Staff receive training and understand how to apply best practices developing and evaluating systems for internal and external use.

Transition to Next Phase

Usability is fully integrated into the systems development culture with a focus on user needs throughout new system introduction. Usability is further tied to the organization's business goals with an emphasis on delivering an excellent user experience. This mindset allows for the execution of usability activities at a Strategic Phase.

Phase 5: Strategic Description

At this phase, usability is recognized throughout the organization as a strategic activity. The business benefits of usability are well understood and usability activities are mandated and measured for all new

products and IT system implementations. When products are sourced from vendors the competitive bidding process includes key usability criteria and a standardized process for measuring whether vendors have met these criteria is a key part of the selection process. (See HIMSS white paper: [Usability Evaluation in EMR Vendor Selection: Selecting a Usable EMR for Your Practice](#)).

Focus on Users

The organization has become human centric. User needs are required input for any new product, process, system selection or introduction. User data is collected and updated on a regular basis.

Management

Management at all levels views usability as a market advantage and understands how to achieve it through UCD. Understanding of, and use of usability principles is criteria for performance evaluation. Usability is fully embedded in the organizational culture and is spread outward into the market place, including client/customers.

Executives understand how to calculate ROI of usability program consistent with the organization's business goals. Usability-related key performance indicators are tracked along with other business success indicators.

Process and Infrastructure

Usability processes, policies, procedures, and practices are standardized across the organization and serve as standardizing elements of any business process. Rather than being a line-item cost on organizational budgets, usability has become a contributor to revenue, a market advantage, and an enhancer of organizational agility.

Cumulative learning of user needs from past projects is documented and used as a starting point for new systems introductions. A knowledge management system is in place to support organizational learning, including all artifacts related to usability and the practice of usability within the organization.

Usability extends beyond internal users to the customers/clients of the organization; thereby ensuring a satisfying experience for all who interact with the organization through their systems and processes.

Resources

Usability contributes to informed and intensive management of human resources. Staff are hired and retained with usability skills and knowledge as key factors and outside experts are retained as needed to support internal resources and help evolve the usability program.

Education

Usability practitioners receive advanced training on best practices and emerging methods and trends in the usability industry. There is on-going usability training within integrated development teams.

The following table gives a detailed summary of the model elements across the dimensions discussed in the previous section.

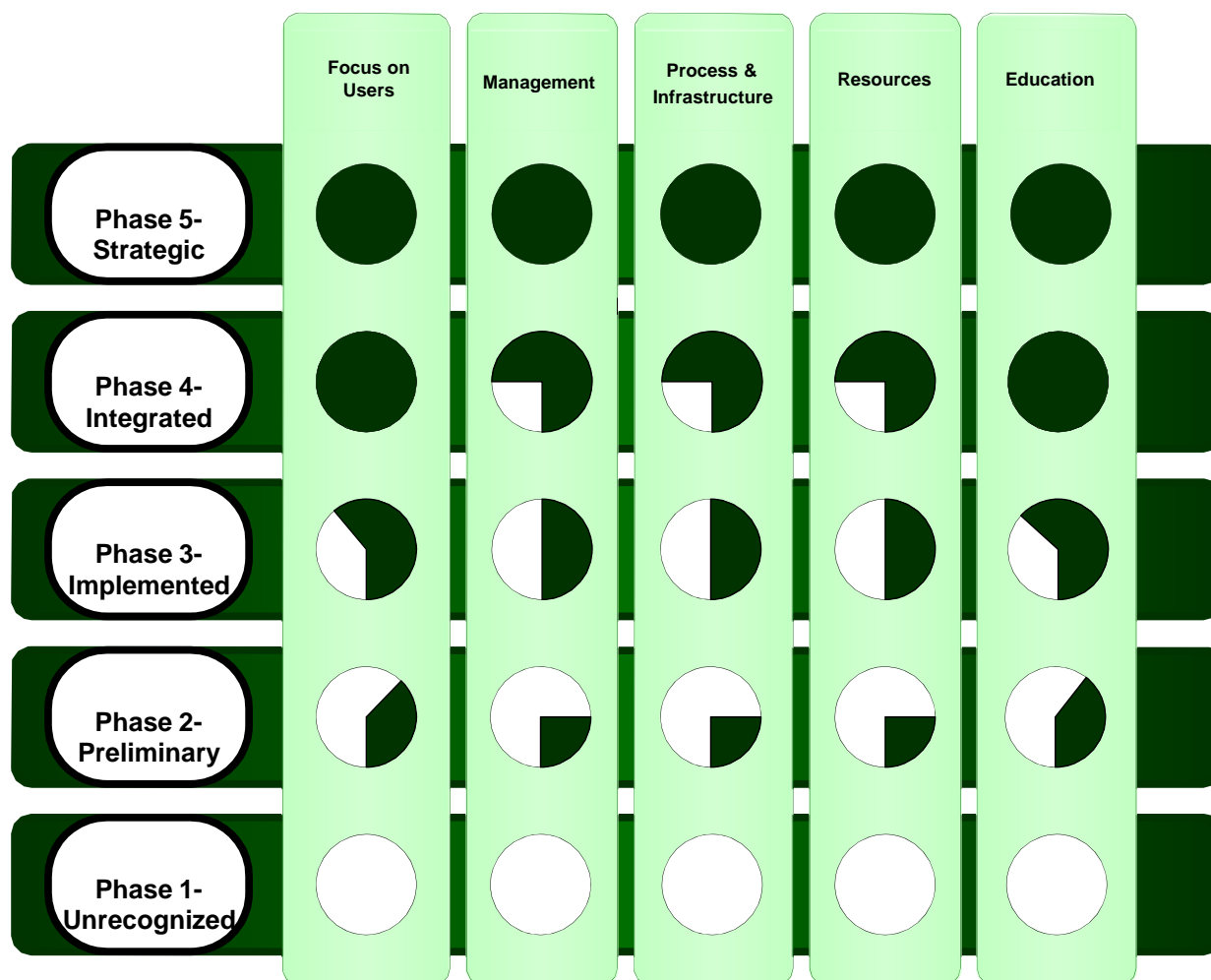
Table 7. Detailed Maturity Model Phases and Characteristics

Phase	Unrecognized	Preliminary	Implemented	Integrated	Strategic
Description	<ul style="list-style-type: none"> Organizational lack of awareness of usability. Organization does not recognize usability as the core problem. Resistance to usability methods from IT groups. 	<ul style="list-style-type: none"> Limited inclusion of usability in system development and deployment. Sporadic or limited attempts to include usability practice in the organization. Insufficient budget or resources to do all the work required. No resources or influence to mandate organizational change. Reliance on outside experts to execute most usability activities. 	<ul style="list-style-type: none"> Organization has small team of usability practitioners. Some of the infrastructure required to fully integrate usability is apparent. Organization may develop usability standards and processes for assessing systems for introduction. For internal development: a library of design patterns and previous test results to improve the efficiency of usability activities. 	<ul style="list-style-type: none"> All benchmarks of a usability program are implemented. Usability group has a recognized mandate. Accountability is achieved through objective setting and measurement. Usability group is involved in the selection and introduction new systems. Critical resources and infrastructure are in place to support usability activities. 	<ul style="list-style-type: none"> Usability program is recognized as strategic. Business benefits of usability are well understood. Usability activities are mandated and measured for all new IT system implementations. When products are sourced the competitive bidding process includes key usability criteria. A standardized process for measuring whether these criteria are met is a key part of the selection process.
Focus on Users	<ul style="list-style-type: none"> None: focus is on product, processes and 'market'. 	<ul style="list-style-type: none"> Emerging focus on end-users. Focus is on individual users and their issues rather than user groups. 	<ul style="list-style-type: none"> Users are recognized, but needs may be traded off for other considerations. 	<ul style="list-style-type: none"> Users are formally recognized and user focused development is mainstream. 	<ul style="list-style-type: none"> The organization has become human-centered.
Management	<ul style="list-style-type: none"> Usability is not a management concern. There is no usability policy in place. 	<ul style="list-style-type: none"> Senior management realization that usability is an issue to be considered in certain functional areas. Little or no management of UCD process. Project driven 	<ul style="list-style-type: none"> Senior management is aware that some workflow issues and staff dissatisfaction are related to usability issues. Proactive approach to usability issues. Usability may have limited 	<ul style="list-style-type: none"> All levels of management are fully aware of usability issues and the need to address them for purposes of care quality and staff satisfaction. Management begins to link ROI of usability program with the 	<ul style="list-style-type: none"> Usability is viewed by senior management as a market advantage. Usability is a criterion for performance evaluations. Usability is embedded in organizational culture. Usability key

	usability activities.	organizational mandate.	organization's business goals.	process indicators (KPI's) are routinely tracked.	
Process & Infrastructure	<ul style="list-style-type: none"> • No processes exist • Usability not recognized as a measurable criteria 	<ul style="list-style-type: none"> • Some usability processes are documented and repeatable. but no continuous usability improvement plan is in place. • These projects have non-standard benchmarking place. • Beginning of a systems approach to usability. • Usability information begins to be collected. 	<ul style="list-style-type: none"> • Usability processes for a small number of IT applications. are documented and achieve consistent results. Usability improvement plan is in place. • Usability plan is sometimes used when processes reach across the organization. • Benchmarks for usability assessment begin to be standardized. • User interface tools are used in new technology development and implementation. 	<ul style="list-style-type: none"> • Usability standards and polices are in place. individuals and projects are accountable. • Usability processes are used consistently and reliably across most of the organization. • Benchmarking is in standardized and consistently used 	<ul style="list-style-type: none"> • Usability is fully incorporated across the organization. • Usability extends to customers/clients. • A knowledge management system is in place.
Resources	<ul style="list-style-type: none"> • No resources are allocated to achieving usability. 	<ul style="list-style-type: none"> • Resources may be assigned ad hoc to address a certain instance of usability problem. 	<ul style="list-style-type: none"> • Budget for usability concerns included in the IT budget. • Suitable facilities and tools for usability improvements are provided. • Organization may employ usability consultants to augment IT staff competencies. 	<ul style="list-style-type: none"> • All new and on-going IT projects have allocations for usability. • All projects have at least one usability expert on the team. 	<ul style="list-style-type: none"> • Intensive and informed management of human and other resources. • Knowledge of usability is key factor in hiring and employment.
Education	<ul style="list-style-type: none"> • No usability training is provided to staff. • No awareness of usability as a business indicator for organization. 	<ul style="list-style-type: none"> • IT staff may have some usability training, usually gained on the job rather than from a formal training process. • Internal training on users and how to assess needs and implement is critical. 	<ul style="list-style-type: none"> • Internal awareness program initiated. • Formal training to broaden usability skills. • IT training on integrating UCD in system development and introduction. 	<ul style="list-style-type: none"> • Updates on recent projects are provided to reinforce the positive impact of usability. • Staff receive training and understand how to apply best practices developing and evaluating systems for 	<ul style="list-style-type: none"> • On-going training of integrated development teams.

The diagram below offers a quick guide for the phases and elements of the Health Usability Maturity Model.

Figure 2. Health Usability Maturity Elements by Phases



Initial Steps for Incorporating Usability to Health Organizations

Despite the benefits of and national attention to usability principles and methods in healthcare projects, individuals may find that their organizations are not attending to usability. This section provides a summary of tactics for incorporating usability into organizations (see Table 8 and Figure 3).^{9, 44,45}

Common Methods for Initiating Usability

Experts indicate that at least four tactics make organizations begin to be aware of usability and its importance.

Table 8. Methods for Initiating Usability into Organizations

Common Methods for Launching Usability in Organizations
• “Wake-Up Calls”
• Individual Infiltration Methods
• Finding Internal Champions
• Using External Experts as a Catalyst

- **‘Wake-Up Calls’**
Organizational changes toward usability can be attained by critical incidents, “wake-up calls.”⁹ Called a “burning platform” in the book *Managing at the Speed of Change*,⁴⁶ this event, or series of events, is significant enough to warrant a change in organizational directions. The event might be uncovering EHR usability-related errors with patient safety impacts, severe productivity issues or a series of complaints by key clinicians about a product’s safety or usability. Individuals can leverage an untoward event to their advantage and keep the momentum toward usability flowing by telling the event story to organizational leaders and proposing recommendations.
- **Individual Infiltration Tactics**
Rhodes⁴⁴ suggests that those interested in improving the user experience begin slowly by talking to various teams, user groups and managers to discover their thinking about the field and to learn what is important to managers. For some managers, the major value is money, but for health settings, managers’ concerns about patient safety and workflow might reign over costs. Then, individuals can begin by giving usability evidence related to the manager’s interests, whether that is reducing project risk, cost savings or errors. Individuals can educate others, including managers about usability⁴⁵ and interview individuals to uncover key usability issues with health IT products.¹⁹

Methods are available for individuals to help ease the transition to incorporating usability into IT projects: building a usability library, helping programmers translate user requirements, gathering evidence about the need for usability in current projects^{44,45} and helping teams understand usability principles and methods. Individuals will want to keep a ready list of projects and outcomes for easy reference. Telling stories about the impact of projects and

leveraging successes can be an ongoing, powerful tactic. Not everyone will embrace usability, so gathering allies is important. A powerful tactic is for individuals to coalesce around critical usability issues, forming a user voice that is not easily ignored.

Individuals might also find that collecting data on a product's usability could serve as a catalyst for change. For example, Zhang and colleagues⁴⁷ used heuristic evaluation techniques to discover extensive usability issues with IV infusion pump designs. Guo and colleagues⁴⁸ conducted a heuristic evaluation on an EHR vendor's electronic medication administration record and found 60 usability issues, categorized into 243 heuristic evaluations. Half of the usability issues were rated as catastrophic or major.

These are important usability issues because less than optimal eMAR designs can easily impact patient safety during nurses' medication administration tasks. A third example is described in the Department of Defense case study below where clinicians banded together to raise issues about the user experience with an ambulatory system. Although this tactic could not be considered a wake-up call, it eventually allowed organizational leaders to realize the importance of improving usability for the system.

- **Finding Internal Champion(s)**

Usability efforts in organizations often begin with one manager or analyst who has an interest in usability.¹² The manager can direct initial projects to include usability methods, gather data about the impacts, and communicate findings to executives for their decision making about expanding usability methods into other projects. Once managers or individuals have the opportunity to speak with executives, presentations should be data-driven, concise and include specific recommendations. An executive champion for usability can be a key element for making and sustaining change.⁹ Most likely, usability will not be the center of an executive's priorities,⁴⁴ so concentrate on providing usability values congruent with the organization's mission and priorities. The business values of efficiency, patient safety and effectiveness will be recognized by executives.

- In healthcare, an internal champion may emerge at any level in any division of the organization. A Chief Medical/Nursing Officer or Chief Medical /Nursing Informatics Officer could recognize the value of usability and lead efforts based upon current experiences with health IT efforts or other endeavors. Champions may emerge as a vocal clinician with more informal organizational power. Individuals in health IT can initiate usability efforts, although "wake-up calls" and emerging internal champions typically are clinical. Potential roles for champions are reviewed in Appendix B.

- **External Expert as a Catalyst**

Organizations may also find external usability experts useful for defining systematic changes to usability methods.⁴⁴ Individuals interested in usability can speak early and often to the consultants and work through them to incorporate usability into their organizations. Usability experts are readily available within and external to health informatics. Organizational leaders may find using external consultants more palatable and quicker than developing internal expertise in usability.

Specific Tactics to Expand Usability in an Organization

Once the initial awareness about usability is attained, efforts can be extended to a number of activities. Leaders and individuals in organizations may find the following in expanded the focus on usability in their organizations.

Figure 3. Expanding Usability Within Organizations



Usability Case studies

These case studies outline health organizations at three different phases of incorporating usability/user experience into their settings: Department of Defense—has recently moved from Phase 1 and entered Phase 2 of the new Health Usability Maturity Model; Baylor Health Care Systems is at Phase 2, moving to Phase 3 and University Health Network, Toronto is at Phase 4 and transitioning to Phase 5. The cases describe: a) the organizational context and the impetus for usability, and b) steps for incorporating usability and impact.

Case 1: Department of Defense Ambulatory Care System

Organizational context and the impetus for usability. After a decade of design, beta-testing and redesign, the Department of Defense, Military Health System (MHS) deployed the Armed Forces Health Longitudinal Technology Application (AHLTA) ambulatory care system from 2004-06. The system is currently in use at 70 hospitals, 410 clinics and six dental clinics.

A key focus of the system is to store data in a central location to give healthcare providers access to a patient's electronic health record from any military treatment facility world-wide. Significant problems have plagued the system since it was implemented including, system speed, usability and availability.⁴⁹ Clinicians complain the system is too slow, does not support their workflow, lacks a user friendly interface, does not support user-customizable patient data and is missing key clinical capabilities.⁴⁹ Military providers indicated that the system issues are so severe that AHLTA is listed as one of the primary reasons providers leave the DoD.^{16,50} Two recent studies document AHLTA usability issues. One identified 175 usability issues (violations) with 22 rated as severe by human factors experts¹⁷ and a second laboratory study found that clinicians' typical tasks require an average of 160 steps and take 22 minutes.¹⁸

Incorporating usability & impact. Several initiatives have been implemented to increase AHLTA system usability. The Army Medical Command AHLTA Provider Satisfaction (MAPS) is currently implementing an initiative aimed at increasing the effectiveness of clinical documentation by reducing the time required to document medical notes. MAPS involves implementing and training on tools including a wireless tablet PC, voice recognition software, macro note typing program, and a digital consent form program. Leaders hope these tools will significantly increase the usability of the system, improve provider satisfaction and increase the efficiency and accuracy of clinical documentation. A targeted, large-scale training strategy was developed and has been deployed in support of these efforts to include workflow analysis. While it is recognized that MAPS is not a panacea for AHLTA, it is an effort to improve providers experience with the system. The results and outcomes of these initiatives are pending as the MAPS implementation is ongoing.

Case 2. Baylor Health Care System, Dallas

Organizational context and the impetus for usability. Baylor Health Care System is an integrated health care delivery organization in Dallas-Fort Worth region, with 14 acute-care hospitals. Implementation of in-patient EHR system started in 2008. At this writing, four of the hospitals have gone live with nursing documentation modules from a commercial vendor. Right after nursing and pharmacy modules were implemented, complaints were received, some of which were related to usability. These included user difficulties in locating places for documentation and finding information; time consuming, duplicative charting, and inconsistent data propagation.

Clearly as first implemented, the EHR required significant amount of post-go-live changes. After the complaints were received, Harrington and colleagues conducted a heuristic evaluation, identifying over 300 heuristic violations in the critical care nursing documentation modules alone, including confusing icons, non-standard terms, and words and terms not used by nurses.⁵¹

Incorporating usability and impact. BHCS benefits from a number of key leaders who actively prepare the organization through such activities as (1) developing guiding principles for safe design and operations; (2) championing focused heuristic evaluation as nursing research projects; (3) initiating organizational structure and processes for post-implementation optimization; (4) hiring a human factors engineer; (5) conducting time-motion studies; (6) sponsoring a usability conference; and (7) encouraging IT specialists to shadow clinicians. Education and support resources in human factors were viewed as key in the organization's strategies.

The initial investment in usability was reflected in three aspects. (1) Results from heuristics evaluation were distributed and used as a key reference to understand challenges of user-centered design. Forums were provided in leadership and staff meetings to discuss usability through examples; (2) budget was set aside for developing and implementing a human factors curriculum that was customized to support learning. A national leader in usability was engaged in designing the curriculum, which contained hands-on “course projects;” and (3) work groups were formed to work on practical guides for interface design (“style guide”) as resources for design teams, together with access to industry standards (such as standard terminologies). The investment so far has led to increased awareness by design teams and commitment for education by leaders. Usability engineering practices have been actively considered in implementation, such as planned usability evaluation.

Case 3. University Health Network, Toronto

Organizational context and the impetus for usability. More than 10 years ago, the teaching hospitals of the University Health Network (Toronto, Canada) recognized that technology challenges extended beyond the mere *reliability* of IT systems and medical equipment. As one of the largest health technology purchasers in Canada, the Health Network recognized that technology adoption and user-error was closely tied to the design of technology and human factors. Despite systems and equipment that worked precisely as the vendors had specified and built, systems were difficult to use for hospital staff and in some instances were contributing to adverse events.

Incorporating usability and impact. A federal grant allowed the health system to accelerate innovation in health technology and build a state of the art usability facility dedicated to human factors issues in healthcare in 2004. The 15,000 square-foot facility has 6,000 square feet of simulation and usability labs used for the design and evaluation of healthcare technologies (healthcarehumanfactors.com).

A team of 12 human-factors (HF) and biomedical engineers, and cognitive psychologists (supported by eight graduate students) conducts design and evaluation projects and original research for public and private entities, including hospitals, policy makers, government agencies and technology vendors and manufacturers.

Specific efforts include: (1) **assisting companies in the design (or redesign) of their products;** (2) **assisting hospitals in procurement decisions** using usability testing methods; (3) **original research in the use of human factors;** (4) **HF101 for Healthcare:** Open, monthly half-day sessions on the fundamentals of human factors in healthcare aimed at the healthcare provider (over 500 hospital staff clinicians have participated in these classes); (5) **Informing policy makers.**

The result of these efforts is that (1) the hospital’s risk management program now includes HF staff to investigate severe and critical incidents and reports to the Quality of Care Committee of the hospital lead by the CEO; (2) a new healthcare human factors course for graduate students in health informatics is now offered at the University of Toronto and is led by faculty from the UHN Healthcare Human Factors team, ensuring that future informatics students have the skills and focus to ensure user-centered information and communication systems are deployed.

Recent National Documents on Usability

Usability is a recent topic of interest in the U.S. informatics community. Several national efforts, namely from the Agency for Healthcare Research and Quality (AHRQ), HIMSS, the National Institute for

Standards and Technology (NIST) and Technology Guiding Nursing Education Reform (TIGER) published material on usability, primarily focused on the usability of EHRs. This section provides a list of recent reports in reverse chronological order and includes links to a summary and the full document for interested readers.

1. [**NIST Guide to the Processes Approach for Improving the Usability of Electronic Health Records**](#). NIST. November, 2010. [Summary](#)
2. [**Customized Common Industry Format Template for Electronic Health Record Usability Testing**](#). NIST. November 2010. [Summary](#)
3. [**Selecting an EMR for Your Practice: Evaluating Usability**](#). HIMSS EHR Usability Task Force, August 2010. [Summary](#)
4. [**Electronic Health Record Usability: Vendor Practices and Perspectives**](#), AHRQ, May 2010. [Summary](#)
5. [**Electronic Health Record Usability: Interface Design Considerations**](#), AHRQ, October, 2009. [Summary](#)
6. [**Electronic Health Record Usability: Evaluation and Use Case Framework**](#). AHRQ, October, 2009. [Summary](#)
7. [**Defining and Testing EMR Usability: Principles and Proposed Methods of EMR Usability Evaluation and Rating**](#). HIMSS Usability Task force, May, 2009. [Summary](#)
8. **TIGER (Technology, Informatics Guiding Educational Reform)**. Incorporating usability in nursing products and practices. Report from the TIGER Usability Collaborative. [Summary](#)
 - a. Full documents available at: Stagers, N, Troseth, M. TIGER Summary Report: Usability and Clinical Application Design Collaborative. Technology Informatics Guiding Educational Reform (TIGER). (monograph). 2009.
Stagers, N, Troseth, M. Usability and Clinical Design. In M Ball, JV Douglas, P Hinton Walker, D DuLong, B Gugerty, KJ Hannah, J Kiel, S Newbold, J Sensmeier, D Skiba, M Troseth (Eds.), *Nursing Informatics: Where Technology and Technology Meet* (4th ed.), Chapter 14. New York: Springer. 2011.

Usability Web sites and Resources

1. [The Usability Professionals' Association](#): Supports people who research design, evaluate the user experience of products and services.
2. [Jakob Design for Care](#): Methods and practices for effective design across healthcare for all situations.
3. [Nielsen's Web site](#): Tips on usability and design, available at: useit.com

4. [Eric Schaffer's blog](#)
5. Video on user experience return on investment by [Dr. Susan Weinschenk](#).

Appendix A:

Summaries of Documents on National Efforts on Usability

1. *NIST Guide to the Processes Approach for Improving the Usability of Electronic Health Records*. NIST. November, 2010.

Report Summary: One of the main purposes of this document is to provide practical guidance on methods relating to User-Centered Design (UCD) and usability testing for EHR development. Specific information is provided on to how to recruit participants, develop the moderator's guide, write tasks, conduct usability tests, record the data, develop the report, and, ultimately, improve the application.

UCD serves to engineer improved usability and human performance into a system or device. UCD models have the following principles:

- Understand user needs, workflows and work environments.
- Engage users early and often.
- Set user performance objectives.
- Design the user interface from known human behavior principles and familiar user interface models.
- Conduct usability tests to measure how well the interface meets user needs.
- Adapt the design and iteratively test with users until performance objectives are met. UCD is an iterative process that serves to continually improve the application.

Usability testing is a core component of user-centered design. The point of doing a usability test is to improve the EHR whether that means its workflow, navigation, screen layout, interaction, visual design, etc. One should test early in the design/development process (formative testing) continuously through to the final phases of development (summative testing). Specifics are available about user testing in the document.

Source: Schumacher RM, Lowry SZ. *NIST Guide to the Processes Approach for Improving the Usability of Electronic Health Records*. Document number NISTIR 7741. Rockville, MD: National Institute of Standards and Technology, Department of Commerce. November, 2010.

Available at: http://www.nist.gov/itl/hit/upload/Guide_Final_Publication_Version.pdf

2. *Customized Common Industry Format Template for Electronic Health Record Usability Testing*. NIST. November 2010.

Report Summary: This document provides a Common Industry Format for EHR usability test reports. It is a modified version of *Software product Quality Requirements and Evaluation (SQuaRE) — Common Industry Format (CIF) for usability test reports* (ISO/IEC 25062:2006(E)), the Common Industry Format (CIF) usability test report. The intention of the CIF is to help vendors demonstrate evidence of EHR usability in a format that allows both independent evaluation of a single product and comparison across multiple products. To use the template, testers must have prior knowledge and skills related to user testing methods.

Source: Schumacher RM, Lowry SZ. Customized Common Industry Format Template for Electronic Health Record Usability Testing. NIST Document number NISTIR 7742. Rockville, MD: National Institute of Standards and Technology, Department of Commerce. November, 2010.

3. *Selecting an EMR for Your Practice: Evaluating Usability.* HIMSS EHR Usability Task Force, August 2010.

Report Summary: This document outlines some basic steps to include in a vendor selection process to help small health practices evaluate EMR usability. While the target audience of this guide is smaller practices, the steps can also be used by large practices and healthcare institutions. The basic steps are:

- Engage your users from the start.
- Consider practice goals.
- Include usability questions in your Request for Proposal (RFP); solicit responses from multiple vendors.
- Review available survey data.
- Perform usability tests with your final two or three EMR product contenders.
- Observe other similar practices using the products (may be done sooner).
- Discuss your findings with the vendor(s) before making a final decision.

Source: HIMSS Usability Task force. *Selecting an EMR for Your Practice: Evaluating Usability.* Chicago, IL: HIMSS. August 2010.

Available at: http://www.himss.org/content/files/Selecting_EMR_Eval_Usability.pdf

4. *Electronic Health Record Usability: Vendor Practices and Perspectives, AHRQ, May 2010.*

Report Summary: Researchers conducted interviews with selected certified EHR vendors to understand their usability processes and practices. **Key findings** were:

- All vendors expressed a deep commitment to the development and provision of usable EHR product(s) to the market.
- The use of user-centered design processes, and specific resource personnel with expertise in usability engineering are not common.
- Specific best practices and standards of design, testing, and monitoring of the usability of EHR products are not readily available. Reported perspectives on critical issues such as allowable level of customization by customers varied dramatically.
- Many vendors did not initially address potential negative impacts of their products as a priority design issue. Vendors reported a variety of formal and informal processes for identifying, tracking and addressing patient safety issues related to the usability of their products.
- Most vendors reported that they collect, but do not share, lists of incidents related to usability as a subset of user-reported “bugs” and product-enhancement requests. Procedures to classify and report usability issues of EHR products are not standardized across the industry.
- No vendors reported placing specific contractual restrictions on disclosures by system users of patient safety incidents that were potentially related to their products.
- Disagreement exists among vendors as to the ideal method for ensuring usability standards, and best practices are evaluated and communicated across the industry as well as to customers.

Many view the inclusion of usability as part of product certification, as part of staying competitive, but also as potentially too complex or as something that will “stifle innovation.”

- Because nearly all vendors view usability as their chief competitive differentiator, collaboration among vendors with regard to usability is almost nonexistent. Many vendors expressed interest in an independent body guiding the development of voluntary usability standards for EHRs.

Based upon their expertise and findings from the interviews, the expert panel made the following **recommendations**:

- Encourage vendors to address key shortcomings that exist in current processes and practices related to the usability of their products. Most critical among these are lack of adherence to formal user-design processes and a lack of diversity in end-users involved in the testing and evaluation process.
- Include in the design and testing process, and collect feedback from, a variety of end-user contingents throughout the product life cycle. Potentially under-sampled populations include end-users from nonacademic backgrounds with limited past experience with health information technology and those with disabilities.
- Support an independent body for vendor collaboration and standards development to overcome market forces that discourage collaboration, development of best practices, and standards harmonization in this area.
- Develop standards and best practices in use of customization during EHR deployment.
- Encourage formal usability testing early in the design and development phase as a best practice, and discourage dependence on post-deployment review supporting usability assessments.
- Support research and development of tools that evaluate and report EHR ease of learning, effectiveness, and satisfaction both qualitatively and quantitatively.
- Increase research and development of best practices supporting designing for patient safety.
- Design certification programs for EHR usability in a way that focuses on objective and important aspects of system usability.

Source: McDonnell C, Werner K, Wendel L. Electronic Health Record Usability: Vendor Practices and Perspectives. AHRQ Publication No. 09(10)-0091-3-EF. Rockville, MD: Agency for Healthcare Research and Quality. May 2010.

Available at:

http://healthit.ahrq.gov/portal/server.pt/community/ahrq_national_resource_center_for_health_it/650

5. *Electronic Health Record Usability: Interface Design Considerations* (October, 2009)

Report summary: This report provides research and policy recommendations for developing EHR evidence for usability as well as policies to improve the usability of EHRs.

An expert panel **recommended funding research** on:

- Documenting patterns of clinician information use in EHR systems.
- Developing and evaluating “use cases” and tools for evaluating EHR implementations for adherence to usability principles and best practices.
- Developing an understanding of, and ways to measure the impact of usability and information design on ergonomic (navigating, documenting) and cognitive (reading, thinking, deciding) workload, data awareness and comprehension, patient safety, clinician decision making and efficiency of care delivery.

- Documenting the effectiveness of adaptive displays, defined as those data displays that change the nature or format of information presented for viewing on specific patient characteristics or physician preferences.
- Assessing current vendor and health care organization practices with regard to information design in EHR product development lifecycle and implementation.
- Identifying and evaluating existing evidence-based style sheets and guidelines for EHRs.
- Identifying and evaluating innovative ways to display complex information in EHRs.
- Identifying best practices in the use of shared (patient-clinician) EHR views, including applicable privacy and confidentiality issues.
- Promoting fellowships in the area of EHR usability and information design.

The panel also **recommended these policy actions:**

- Establishing certification requirements for EHRs, based on a practical and fair process of usability evaluation: Include usability/information design as an essential part of the certification process.
- Requiring/strongly recommending that vendors establish and document their programs for testing the usability of their systems (people and processes), including evaluating potential impacts on quality and safety. Include EHR design and functionality in standards and guidelines.
- Developing a National EHR usability laboratory to: Support public-private collaboration and sharing of best practices in this area. Develop tools and processes to support evaluation of products and implementations. Assist health IT vendors in product development and health care organizations in effective implementation of EHRs.

Source: Armijo D, McDonnell C, Werner K. Electronic Health Record Usability: Interface Design Considerations. AHRQ Publication No. 09(10)-0091-2-EF. Rockville, MD: Agency for Healthcare Research and Quality. October 2009.

Available at:

http://healthit.ahrq.gov/portal/server.pt/community/ahrq_national_resource_center_for_health_it/650

6. Electronic Health Record Usability: Evaluation and Use Case Framework. (October, 2009).

Report Summary: This report provides **best practices** for EHR usability and **use cases** for evaluating the design of computerized systems in primary care settings.

Best usability assessments include heuristic evaluation and **EHR-specific design principles** such as:

- Designs to support cognitive and environmental stressors
- Designs for collaborative work processes
- Displays to facilitate quality care
- Information should be action-oriented
- Information should be adapted to the individual patient
- The source of displayed data should be apparent
- Designs should support privacy and security

Use cases are for:

- Acute episodes.
- Chronic conditions.

- Preventative and health promotion.
- Undifferentiated symptoms.

Source: Armijo D, McDonnell C, Werner K. Electronic Health Record Usability: Evaluation and Use Case Framework. AHRQ Publication No. 09(10)-0091-1-EF. Rockville, MD: Agency for Healthcare Research and Quality. October 2009.

Available at:

http://healthit.ahrq.gov/portal/server.pt/community/ahrq_national_resource_center_for_health_it/650

Healthcare Information Management and Systems Society

7. *Defining and Testing EMR Usability: Principles and Proposed Methods of EMR Usability Evaluation and Rating.* (May, 2009).

Report Summary: This report provides a list of **common usability principles** and provides samples of objective, repeatable and cost-efficient **test scenarios for evaluating EMR usability**.

Key usability principles, especially those applicable to EMRs, were derived from the literature and are:

- Simplicity.
- Naturalness.
- Consistency.
- Minimizing cognitive load.
- Efficient interactions.
- Forgiveness and feedback.
- Effective use of language.
- Effective information presentation.
- Preservation of context.

Evaluation methods and metrics are discussed for:

- Efficiency.
- Effectiveness.
- Cognitive load.
- Ease of learning.
- User satisfaction.

Recommendations for conducting usability testing include:

- Start small.
- Create measures.
- Create a 5-star rating system.
- Define the (testing) process.
- Improve with time.
- Encourage others to do their part (e.g., vendors).

Source: HIMSS Usability Task Force. *Defining and Testing EMR Usability: Principles and Proposed Methods of EMR Usability Evaluation and Rating*. Chicago, IL: HIMSS. June, 2009.

Available at: http://www.himss.org/content/files/HIMSS_DefiningandTestingEMRUsability.pdf

8. **TIGER (Technology, Informatics Guiding Educational Reform).**

Report Summary: The purpose of the Technology Informatics Guiding Educational Reform (TIGER) Initiative was to identify information/knowledge management best practices and effective technology capabilities for nurses. The Initiative catalyzed relationships between national nursing organizations and informaticists by developing 9 collaboratives during 2007-2009, one of which addressed application design and usability of products for nurses. The usability collaborative:

- Synthesized a comprehensive literature review from nursing and other disciplines
- Collected case studies and examples that illustrate usability/clinical application design – consisting of good examples to follow and bad examples to avoid
- Developed recommendations for health IT vendors and practitioners to adopt sound principles of usability and clinical design for health care technology

Sample recommendations include:

- Consider the requirements of different skill levels of practitioners. A novice nurse may need prompts and guidance more than an experienced nurse. Allow nurses to choose their own level of user interface support.
- The requirements process should be owned by clinicians, not the information technology (IT) department or the vendor
- Complete a workflow analysis for each user/department touching an electronic health record. Workflow includes identifying who, what, where, when, why by including specific participants, information being collected and with whom information is being shared
- Clinical application development should be clinician-driven and not engineer-driven
- Consider the environment in which the technology will be used. Location, temperature, surrounding objects will all affect the way technology will be used (or not) and how users create workarounds
- Test for situational awareness in decision making. This accounts for all the interactions between a person and a system, together with the conditions that must be satisfied if the interactions are to be effective
- Testing is not the sole responsibility of organizations implementing product(s). Usability testing should be a part of every vendor's processes
- Plan on usability evaluations being included in customer contracts

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Appendix B

Informatics Roles and Functions in Healthcare Organizations

CIO - Chief Information Officer

- Interacts with all the health organization's departments such as nursing, finance, medical records, laboratory, etc.
- Responsible for the organization's information technology strategic plan and management of computer systems to support health organization's goals.
- Usually reports to CEO (Chief Executive Officer) or COO (Chief Operating Officer).

CMO - Chief Medical Officer

- Liaison between the medical staff and administration.
- Responsible to ensure quality care delivery and patient safety and medical staff supervision.
- Usually report to the CEO (Chief Executive Officer).

CMIO - Chief Medical Information Officer

- Liaison between medical staff and IT departments.
- Responsible for developing strategic plans regarding clinical systems and information management, stakeholder engagement and communications, clinical systems selection, design, workflow integration, development and testing, implementation, and standards and policies to support the systems and organizational change.
- Works in conjunction with CNIO and usually reports to CMO and/or CIO.

CNO - Chief Nursing Officer

- Liaison between the nursing staff and administration.
- Responsible to ensure quality care delivery and patient safety, nursing and clinical professional staff supervision, and the coordination and monitoring of regulatory compliance.
- Usually reports to the CEO (Chief Executive Officer).

CNIO - Chief Nursing Informatics Officer

- Liaison between hospital management, IT department and nursing departments.
- Responsible for developing strategic plans regarding clinical systems and information management, stakeholder engagement and communications, clinical systems selection, design, workflow integration, development and testing, implementation, and standards and policies to support the systems and organizational change.
- Works in conjunction with CMIO and usually reports to CNO and/or CIO.

Clinical Systems Director/Manager/Analyst

- Liaison between clinical end-users and IT department.
- Responsible for developing strategic plans regarding clinical systems and information management, stakeholder engagement and communications, new systems research, clinical systems selection, design, workflow integration, development and testing, implementation, trouble shooting end-user system challenges, performs systems checks, supports organizational change through the use of technology.
- Works in conjunction with CMIO and CNIO. May report to CMIO, CNIO, CMO, CNO and/or CIO.

Super User

- Front-line clinical experts who provide leadership in their area of expertise to the Clinical Systems and IT departments when organizations introduce new technologies.
- Responsible to communicate their knowledge of unit/area workflows, current policies/procedures, participate in designing, testing, training and implementation of new systems, modifications and upgrades, embrace change and coach others through change management process.
- Usually report to management in their area of expertise.

End-User

- Person who uses the health information technology.
- Reports to management in their department / division.

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